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ABSTRACT

Using hands-on activities and the "Plan, Do, Review" approach, this physics curriculum for 4-year-olds is designed to develop an early interest in and enthusiasm for science and to excite children about learning in general. The curriculum is designed to be implemented biweekly in preschool or child care programs but may also be presented at a science center or museum. The introduction to the curriculum describes its philosophical underpinnings and the general structure for learning sessions. Part 1 of the curriculum presents four activities conveying the following concepts: (1) magnetic properties of attraction and repelling and magnetic fields; (2) complete circuits which allows electricity to flow; (3) properties of light, including shadows, reflection, refraction, and source of energy; and (4) machines making work easier. Each activity description details the scientific concept, delineates instructional procedures, and lists additional activities. The sessions begins with a group time, including a story to introduce the relevant concept. Teachers introduce children to possible activities, and place materials in learning centers. Adults join children in learning centers, engaging them in questions intended to enhance their understanding. After activities have been completed, children return to group time to share their activities. Part 2 of the curriculum contains additional instructions for each activity and some of the materials used. Part 3 lists books and presents fingerplays and songs relevant to physics principles and appropriate for preschool children. (KB)

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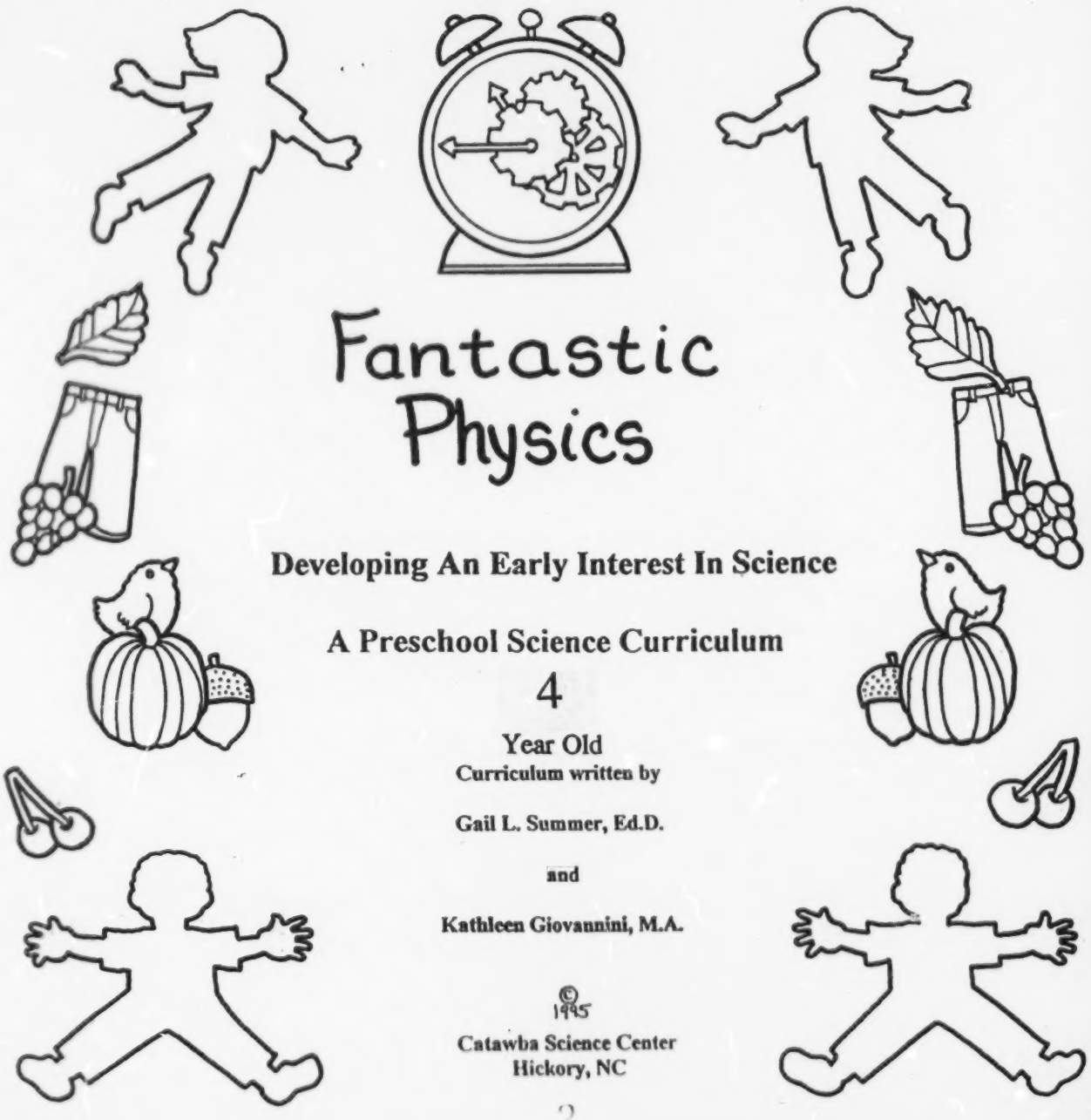

Fantastic Physics

Developing An Early Interest In Science

A Preschool Science Curriculum

4

Year Old

Curriculum written by

Gail L. Summer, Ed.D.

and

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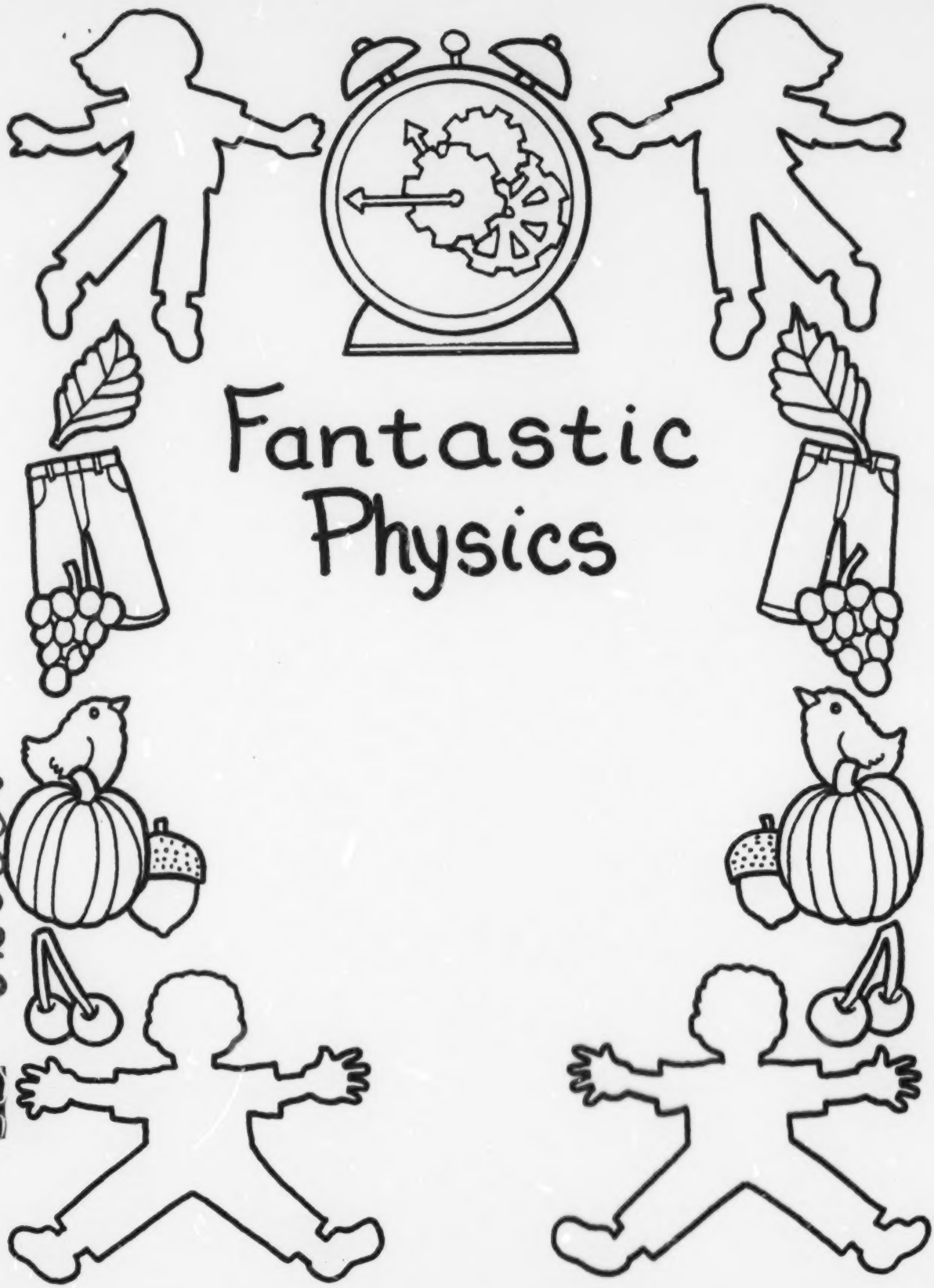
Hickory, NC

PS 026537



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Introduction

Philosophy

Developing an Early Interest in Science has been designed to not only develop an early interest in and enthusiasm for science, but also to excite young children about learning and discovering in general. While science is the content, the approach with which that content is presented is crucial to the success of developing an early interest in science and learning.

The young child learns in unique ways. The young child must experience science concepts. Simply talking about scientific concepts doesn't allow the child to understand and therefore attach meaning to the concepts. Perhaps the old Chinese Proverb, "I hear and I forget; I see and I remember; I do and I understand" is a good reminder of how the young child needs to experience the world. Doing is the key.

Given how the young child learns, **Developing an Early Interest in Science** is based on a modification of the Plan, Do, Review approach devised by High Scope in Ypsilanti, Michigan. The Plan, Do, Review approach introduces the concept and choices for the day, then allows each child to "plan" their activities by stating their choices for that day. After each child "plans," each implements his/her plan by "doing," or engaging in the activities selected. While the children are "doing," the teachers are interacting with them, asking questions to further elaborate the learning. After "doing," the children regroup and "review" by sharing what they did while interacting with the activities that day. The purpose of the Plan, Do, Review approach is to allow children control over their learning, while still holding them responsible for what they are learning.

Program Description

Developing an Early Interest in Science has been designed to be an outreach early childhood program. In its original form, a science educator from the Catawba Science Center in Hickory, NC visited child care/early childhood programs on a bi-weekly schedule. With each visit, one session was shared with the children. Teachers in the child care programs participated in training workshops prior to each new unit (units consisted of 4-6 sessions). The purpose of the workshops was for the teachers to make resource activities they used in their classroom after the session and to also gain an understanding of the concepts to be better able to assist the science educator while she was in their classroom.

Replication of the program in its original form is possible, but variations are also possible. The sessions could be presented at a science center with the children travelling to the museum rather than the educator travelling out to the children. The sessions may also be presented to small groups of parents and their preschoolers at a science museum for a brief morning session, somewhat similar to the library story hour idea enjoyed by parents and preschoolers for years. The sessions are also easily adaptable by teachers in child development centers for use in their own classrooms. Each session provides suggestions for numerous center ideas to enrich science activities throughout the preschool curriculum. With a little flexibility, the curriculum presented here can fit many formats and needs.

Session Description

In **Developing an Early Interest in Science,** each session begins with a circle or group time, with a song to say hello to everyone, and a story to introduce the concept for that

session. Children are then introduced to all the possible activities for the session. As the activities are shared, they are placed in learning centers around the room. After the activities are all introduced, and the children have watched where each has been placed in the learning centers, the children "plan" as they are asked one by one what they would like to do during that day's session. (This whole introductory process takes about 10 minutes.)

As children make choices, they are dismissed from the circle to begin the "do" part of the cycle by engaging in their choices in the learning centers. Adults join the children in their activity in centers by floating from center to center to engage children in questions which enhance their activity and understanding. As children complete one activity, they may choose another activity in their plan. Children are not expected to rotate through the activities on an adult schedule or in groups of prearranged partners. Some children may only complete one activity during a session due to total engagement with that activity, and that's just fine. Other children may complete several activities and that's acceptable too. There is no predetermined number of activities which should be completed and no child is forced to interact with a particular activity.

After the time for "doing" has been completed (usually about 25 minutes), the children return to the circle group time to share ("review") what they did in centers. The teacher often helps this process by asking "Johnny, what did you play with in centers today?" When a child has a hard time remembering, or is quiet and unsure of reviewing at first, the teacher can help by suggesting, "Did you play with the magnets today? What happened when you used the magnet?" The teacher is able to ask Johnny about his "plan" because she floated through the centers and observed what each child did. (Reviewing takes about 5 minutes.) After each child has had a chance to review, the concept for the session is reemphasized or recapped by the teacher, and the session is ended.

Activities

The activities which are included in **Developing an Early Interest in Science** are all hands-on, manipulative activities. Every effort is made to make the concept for each session real and meaningful for children by allowing them to experience it. For example, rather than just talk about the fact that water flows because it is a liquid, the children actually pour water through clear tubes and watch the flow in action. Rather than talk about internal body parts children can't see, special dolls are used which allow children to uncover those hidden inside body organs such as hearts and lungs. Whenever appropriate books and puppets are used to enhance language. Science develops wonderful vocabulary! Puzzles are used to help children develop fine motor skills and explore science.

Real materials are used whenever possible. Real butterfly displays are explored rather than exclusively using colored pictures of butterflies. Real rocks of a wide variety are provided. Both real and replica fossils are manipulated. There is much to be said for allowing children to experience the "real thing." Yes, some science materials are fragile, but children will never learn to be careful unless there is reason to be so. Imagine touching and feeling a real fossil from a dinosaur! It takes little enticement to be gentle with a thing so old, if children are only reminded just how precious fossils are.

Resource Activities

Developing an Early Interest in Science has also been designed to include resource or enrichment activities to further extend the concepts from each session. Some resource

activities suggest the use of real objects easily obtainable. Many other resource activities are made with patterns to produce manipulative games with which to review session concepts. Masters of the patterns and directions for their use are included with the curriculum. A brief listing of the resource activities made from the patterns along with additional suggested activities can be found in the session descriptions. More detailed directions for assembly of patterns to make the resource activities can be found in the teacher resource activity section. Lists of suggested books, fingerplays, and songs to be used by the classroom teacher in order to infuse the science concepts throughout the child's day are also included in a separate section of the curriculum.

Using **Developing an Early Interest in Science**

Whatever format meets your particular needs, it is important that you read the session through before trying it. As you read the session procedure, try to picture how and where you will lay out the center activities. Review the storybooks suggested and read them before the sessions. Practice the fingerplays before the session too. Anticipate the questions children will ask. Perhaps most important, get excited about what you will be sharing with the children! Your enthusiasm is contagious!

A suggested list of materials used in the centers is included with each unit. From time to time, materials are discontinued by manufacturers. If this should happen before you can access the materials suggested, review the session to determine how that particular material was used and select a substitute item. While the materials suggested worked well, there's nothing to say that a substitute item might not do just as well or even better.

Most important in using **Developing an Early Interest in Science** is to encourage children to play, interact, and enjoy. An early interest in science cannot be developed if children are chastised for messes and trying something that wasn't the adult intention. Science requires hypotheses and tests for hypotheses. Children are natural "little scientists" if allowed to explore. So relax and watch those little scientists blossom!

Fantastic Physics

Session Activities

Four-Year-Olds

FANTASTIC PHYSICS

Four-Year-Olds

Session 1

CONCEPT: Magnets have special properties. (The children will become familiar with magnetic properties of attraction through water, paper, and plastic; the property of repelling; and magnetic fields.)

PROCEDURES:

1. Gather the children in a circle group. Open with a name fingerplay to distribute name tags/review names. Introduce the day's concept with a fingerplay.

2. Review that magnets have special powers. Discuss with the children what magnets do. Ask them to tell you what kind of things magnets attract.

3. Next, pass out magnetic wands and the junk and let the children rediscover what sticks to a magnet and what doesn't. Collect the junk. Now that the children have discovered things that "stick" and things that don't, let them verbally share some of their experiences.

4. Then, demonstrate how a magnet will not pick up an envelope; show how it will pick up an envelope with paper clips sealed inside. Why? Does a magnet's special powers work through paper? Next, pass out envelopes in one color sealed with metal paper clips inside and another color envelope with plastic paper clips inside. Let the children pick them up with the magnets. Why did the magnet not pick up some of the envelopes? Open one envelope of each color to show both the plastic and the metal paper clips. Ask the children which ones stuck to the magnet.

5. Explain to the children that magnets have other special powers. Then tie a bar magnet to a string and demonstrate how you can make the magnet swing by repelling and attracting. Then show the special cars with the magnets on the front and back and how you can make them chase each other by repelling and attracting.

6 Then explain that there's one more special thing to see. This special power a magnet has can actually be seen. Use the large magnet field demonstrator. Let the children see what happens to the metal shavings when the magnet is inserted. What happens? Pass out the individual field demonstrators and magnets. Let the children create their own magnetic fields. The lines are the field or power (force field) the magnet has. Use a variety of magnets to show how different magnets have different fields.

7. Do a fingerplay to resettle the group and prepare to disperse to centers. Once attention is regained, explain the center options available for that day. After you have explained the centers, ask the children to choose where they would like to go. As they choose, send

them on their way. Allow the children to freely play and choose another center as they finish each task. Be sure to float from center to center and interact with the children as they play to reinforce the concepts for the day. The center options today are:

A. Provide the magnetic mazes in the maze holder in a center. (This magnetic maze is a set of thin plastic sheets, each with a different maze. The plastic maze sheets are supported by a wooden frame. Also included is a magnetic wand and wooden person with a magnetic base. The children move the person through the maze from underneath the plastic sheet with the magnetic wand.) Ask the children if the magnet will work through plastic. Let the children try to move the person around the maze. Allow 2 children at this center.

B. Provide the magnetic carts in a center. Ask the children if they can crash the carts. Also ask if they can make the carts chase each other. Let the children explore. Allow 3 children in this center.

C. Provide the magnetic fish in water. Does the magnet work in water? Let the children use the fishing poles to find out. Allow 4 children at this center.

D. Provide the magnetic field demonstrators in a center so that children can see the what the fields of different magnets look like. Allow 3 children at this center.

E. Provide magnets and magnetic chips in a center. Allow children to experiment with the attraction of the chips to the magnet. Remind children why the chips stick to the magnet. Allow 2 children at this center.

F. Provide the magnetic maze in a center. (This magnetic maze is a maze sealed inside a wooden box with a clear Plexiglas top. Magnetic marbles are sealed inside the maze. The children use the attached magnetic wand to move the marbles through the maze.) Ask the children if a magnet works through plastic. Let the children try to move the marble through the maze using the magnet. Allow 1 child at this center.

G. Provide the Magnet Express in a center. (This is essentially the same as the item above, except it has two attached wands.) Ask the children if a magnet works through plastic. Can you work the ball through the maze? Who can get their marble through the maze first? Allow 2 children at this center.

H. Provide the Super Magna Shapes in a center. Ask the children if the magnetic field extends through things. Why do the pieces stack on each other as if they were magnets when only the bottom plate is actually magnetic? Allow 2 children at this center.

I. Provide the wands and junk in a center. Let the children sort items that stick from items that don't stick. Ask the children what can you say about things that stick to the magnet. Allow 3 children at this center.

8. Two minutes before you are ready for the children to clean up, turn out the lights and make an announcement to warn them to begin finishing up whatever they are working on. After two minutes, turn out lights again and ask the children to clean up. Call children back to the group circle with a song. Allow each child to share one thing they learned or played with during center time. Ask the children if magnets work through paper, plastic, and water. Review the power of magnets to attract and repel.

9. Sing the good-bye song and collect the name tags.

RESOURCE KIT:

1. Provide each classroom two wheeled carts and four magnets to experiment with repelling and attracting.

2. Provide each classroom three magnetic wands and an assortment of magnetic and non-magnetic junk.

3. Suggest that the classroom teacher hide magnetic items in the sandbox.

4. Suggest that the classroom teacher hide magnetic items in the water table.

5. Provide each classroom a handful of magnetic chips.

6. Suggest that the classroom teacher experiment with a magnet on a string to show magnetic attraction.

7. Suggest that the classroom teacher allow the children to paint with a magnet through a sheet of Plexiglas.

FANTASTIC PHYSICS

Four-Year-Olds

Session 2

CONCEPT: Electricity comes from a source, travels along wires, and is a form of energy. (The children will become familiar with the concept of a complete circuit which allows electricity to flow to make something function.)

PROCEDURES:

1. Gather the children in a circle group. Open with a name fingerplay to distribute name tags/review names. Introduce the day's concept with a fingerplay.

2. Then, show an electrical plug. Ask the children questions like: What is it? How does it work? What's in the wall behind the socket? How does electricity get to where it needs to go? What is electricity? Tell the children it is a form of energy. It is dangerous for children to put plugs into sockets in the wall. The energy in electricity is very powerful. There is something that children can use. Batteries. They store electricity, but they are safe to use.

3. Next, demonstrate with a large battery and a bell how to hook it up to an energy source to make it ring. Talk about how the wires must make a circle from the battery to the bell and back. Demonstrate what happens when you break the circuit. Have the children make a circle with their thumb and first finger. Make the bell ring. The children should keep their circle of their thumb and finger together as long as the bell is ringing. Stop the bell. The children should open their circle now because the bell stopped ringing--the circuit was broken. Play a game where the children control your operation of the bell. Choose a child to be your "circuit." As long as his fingers make a circle, the bell rings, when he opens his fingers and breaks the circuit, the bell stops.

4. Next, introduce that many things must have a complete circuit if they are to work, just as the bell must. Show the electric block set and how to use the wires to make each work. Talk about how the battery block is the energy source, and that the wires carry the energy to the other blocks with the bell, light, or motor. Emphasize the complete circuit/circle that is required.

5. Do a fingerplay to resettle the group and prepare to disperse to centers. Once attention is regained, explain the center options available for that day. After you have explained the centers, ask the children to choose where they would like to go. As they choose, send them on their way. Allow the children to freely play and choose another center as they finish each task. Be sure to float from center to center and interact with the children as they play to reinforce the concepts for the day. The center options today are:

A. Provide the electric blocks in three separate centers. Let the children take turns completing the circuits to the various items. To complete the circuit, the children touch the ends of the wires to the ends of the wires attached to the buzzer, motor, or lights. Ask them to demonstrate what happens when the circuit is broken. Allow 8 children at each center.

B. Provide the large battery and bell in a center. Let the children complete the circuit to make the bell ring. Allow 1 child at this center

C. Provide the motor blocks for the children to connect anyway they see fit. (These "blocks" attach to each other by snapping them together. Once the children complete their creations, one of the blocks has a switch which can be turned on to make the creation move and spin.) Turn on the creation and watch the motor at work! Allow 2 children at this center.

D. Provide the Lakeshore Electricity Center. Let the children complete the circuit with a variety of items supplied with the kit. Why do some objects make the light work while others don't? Allow 8 children at this center.

RESOURCE KIT:

1. Provide two D-size battery holders, two bulb sockets, two flashlight bulbs, and two 5 x 7" masonite boards. Directions for assembling the light board are in the teacher resource packet.

2. Provide a D-size battery holder, motor, propeller, a bathroom size plastic cup, and one 5 x 7" masonite board. Directions for assembling the propeller and motor board are in the teacher resource packet.

3. Provide an Energy Ball. When you hold the energy ball, your hand completes the circuit and the ball glows!

FANTASTIC PHYSICS

Four-Year-Olds

Session 3

CONCEPT: Light has special properties. (The children will become familiar with shadows, mirror reflections, light refraction, and light as an energy source.)

PROCEDURES:

1. Gather the children in a circle group. Open with a name fingerplay to distribute name tags/review names. Introduce the day's concept with a fingerplay.

2. Then, demonstrate how light can be broken into colors using the prism. Talk about how light is special. Light also makes something on a sunny day. Tell the children you are going to read Bear Shadow. Ask the children to watch for what the light makes on a sunny day.

3. Discuss how light casts a shadow the same shape as the object. Set up a shadow stage made from a shoe box. Show cut outs (stencil shapes) and let the children guess what they are by the shape of the shadow.

4. Then introduce that light allows us to see things in a mirror, too. Without light, the reflection in the mirror wouldn't be seen. Demonstrate how a reflection in a mirror can complete an object cut in half.

5. Explain how light is also an energy source. Demonstrate how solar panels, when a light is shined on them, make a toy work. Show a solar calculator as an example of how we use solar energy every day. Ask the children if any of them use solar energy at their homes.

6. Do a fingerplay to resettle the group and prepare to disperse to centers. Once attention is regained, explain the center options available for that day. After you have explained the centers, ask the children to choose where they would like to go. As they choose, send them on their way. Allow the children to freely play and choose another center as they finish each task. Be sure to float from center to center and interact with the children as they play to reinforce the concepts for the day. The center options today are

A. Provide several prisms in a center and let the children use them to see the rainbow. Ask the children to tell you the colors they see. Allow 6 children at this center.

B. Provide the match and sort shadow game in a center and let the children match each object to its shadow. Allow 2 children at this center.

C. Provide a variety of books about light and shadows in a center for the children to read. Allow 2 children at this center.

D. Provide the shadow stage in a center and let the children take turns making shadows and guessing each object by its shadow. Allow 2 children at this center.

E. Provide mirrors and a variety of half pictures in a center so that children can use the mirrors to complete the image in the picture. Bring up the term symmetry and how the picture in the mirror is exactly like the other half. Allow 4 children at this center.

F. Provide hinged mirrors in a center with a variety of pictures. Also place in the center an assortment of small, colorful objects (sequins) in sealed, clear plastic bags. Let children experiment with the hinged mirrors like a hand-held kaleidoscope to make a variety of designs in their mirrors. Allow 2 children at this center.

G. Provide a solar panel in a center with a toy and let children use the reflector reading light to make it work. Allow 2 children at this center.

H. Provide several kaleidoscopes. Allow the children to experiment with the kaleidoscopes and a light source. Allow 6-8 children at this center.

7. Two minutes before you are ready for the children to clean up, turn out the lights and make an announcement to warn them to begin finishing up whatever they are working on. After two minutes, turn out lights again and ask the children to clean up. Call children back to the group circle with a song. Allow each child to share one thing they learned or played with during center time. Review the special properties of light.

8. Sing a good-bye song and collect the name tags.

RESOURCE KIT:

1. Use the two shadow patterns to make two shadow lotto games for the children to match pictures to the shadow they would cast.

2. Use the patterns to make half pictures to be used with mirrors to complete the whole picture.

3. Make unbreakable mirrors with acetate, aluminum foil, and heavy cardboard. (See the teacher resource directions.)

4. Suggest that the classroom teacher provide a variety of catalogue pictures and hinged mirrors to make a tabletop kaleidoscope.

5. Suggest that the classroom teacher provide a variety of bagged sequins, bead, etc. and hinged mirrors to make a tabletop kaleidoscope.

6. Provide each classroom with a packet of Solargraphics to make "shadows" of common objects.

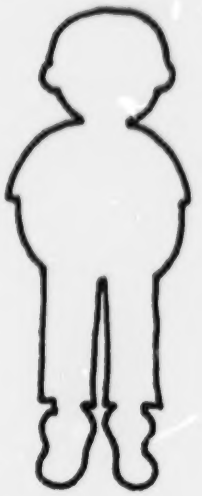
7. Provide a solar panel, motor, propeller, bathroom size plastic cup, and a 5 x 7" masonite board to make a solar powered motor. Directions for assembling the motor board are in the teacher resource packet.

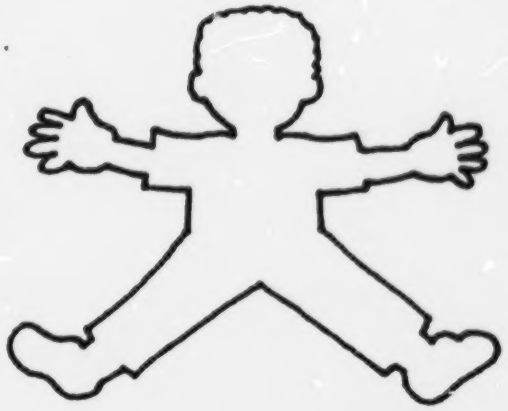
8. Suggest that the classroom teacher provide a variety of objects and a flashlight to experiment with shadows.

9. Suggest that the classroom teacher trace the children's shadows outside at various points in the day.

10. Suggest that the classroom teacher make a shadow box and stencils.

11. Suggest that the classroom teacher cut pictures of the children in half to be used with the mirrors to complete a whole face. Our faces are not completely symmetrical, so the completed faces will look funny!





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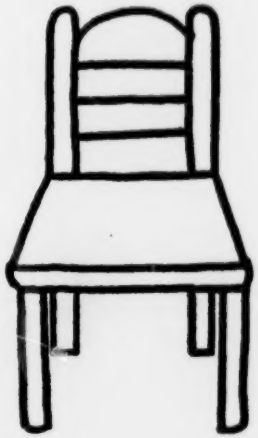

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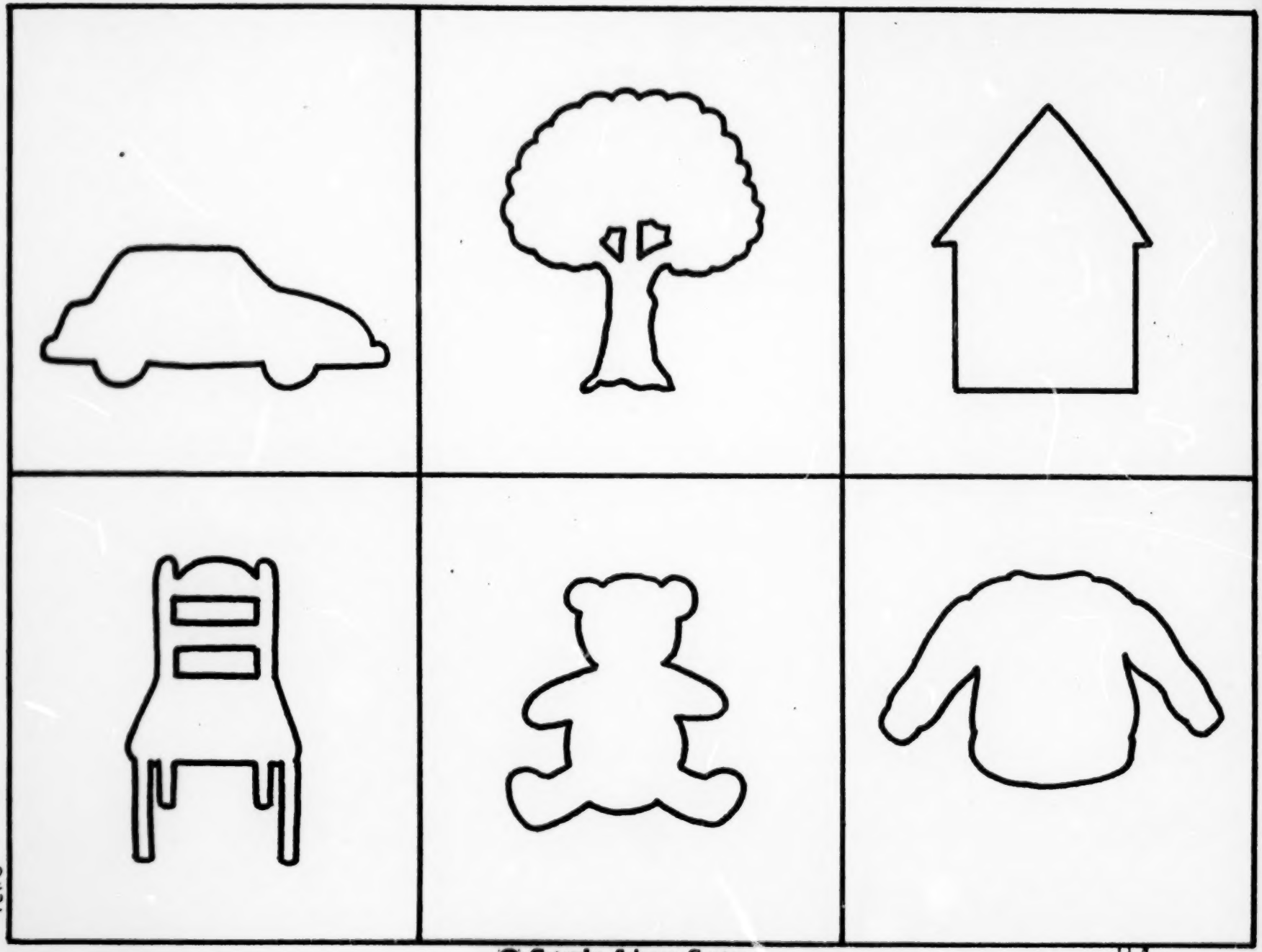

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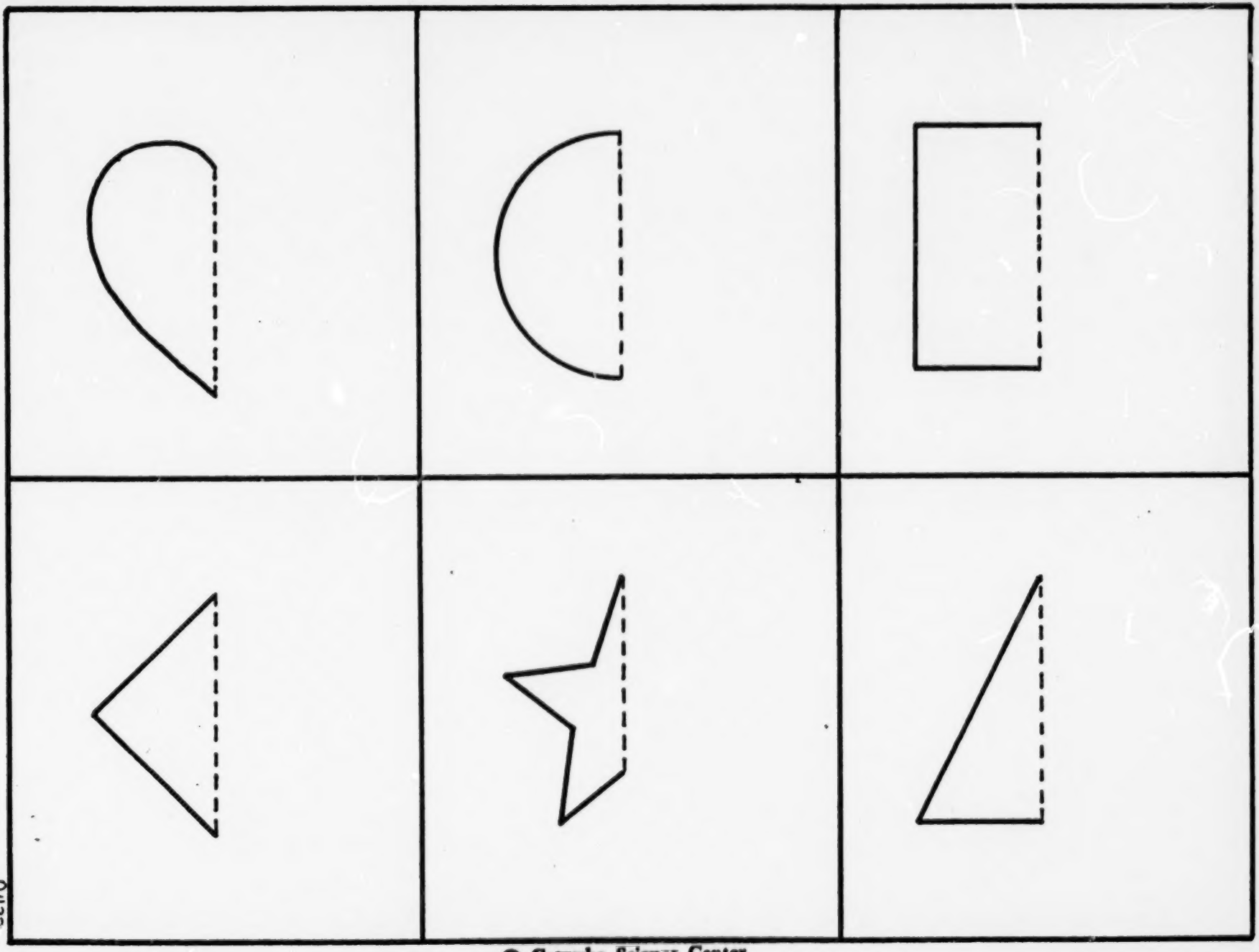

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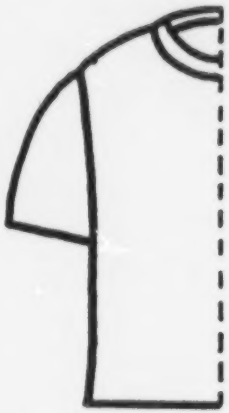

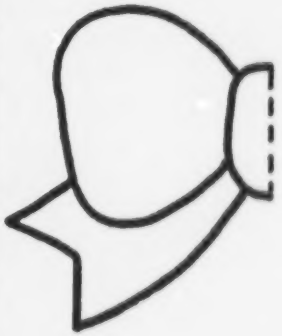

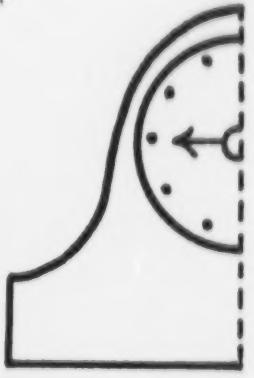

P432

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FANTASTIC PHYSICS

Four-Year-Olds

Session 4

CONCEPT: Machines help us do work. (The children will become familiar with the concept that machines make our work easier. The concept of gears will also be reviewed.)

PROCEDURES:

1. Gather the children in a circle group. Open with a name fingerplay to distribute name tags/learn names. Introduce the day's concept with a fingerplay.

2. Introduce the idea that machines make our work easier. Show the gear train and demonstrate how one gear, when set in motion, makes the second and third gears work, too. Call attention to how the gears must mesh to work. Explain that gears help machines work.

3. Next, use the Genecon hand generator. Show the children how the gears turn inside and work together when you turn the crank. Hook the generator up to a light bulb. Ask what the children think will happen as you crank and as the gears work. Demonstrate and reinforce that the work is transferred from the crank to the gears to the light bulb. Emphasize that many machines have gears inside.

4. Explain that we also use machines to help us in other ways. Introduce the pulley. Point out all the parts and ask the children how they think the pulley works. What do they think a pulley does? Demonstrate the pulley and reinforce how work is transferred from the crank to make the pulley move. How could a pulley be used to help us? Show the crane and magnetic blocks. Show how the crane works. Allow the children to share when they've seen a real crane being used.

5. Do a fingerplay to resettle the group and prepare to disperse to centers. Once attention is regained, explain the center options available for that day. After you have explained the centers, ask the children to choose where they would like to go. As they choose, send them on their way. Allow the children to freely play and choose another center as they finish each task. Be sure to float from center to center and interact with the children as they play to reinforce the concepts for the day. The center options today are:

A. Provide the wooden Gear Train and Pulley in a center for experimentation. Ask children if they can think of anything that uses this type of machine. Allow 2 children at this center.

B. Provide the crane and the magnetic blocks in a center. Allow the children to use the crane to pick up the blocks. Review the magnetic concepts learned earlier too. Allow 2 children at this center.

C. Provide the Gear Circus in a center. (The Gear Circus is a set of plastic gears which can be assembled to create a "circus." The gears can be assembled both horizontally and vertically, so a Ferris wheel can be made as well.) Encourage the children to place the gears so they mesh so that when the crank is turned, the clowns and animals also turn. Allow 3 children at this center.

D. Provide the Look and Learn Car in a center. The children must put together the pieces to make the car go. Once together, watch the gears as the car runs. Push the car to make it go. Allow 2 children at this center.

E. Provide the Turn-a-Design in a center. The children place the small, colorful gears in the board (they will automatically interlock), and then turn the crank to watch their design move. Explain that these gears are what make things like watches work. Allow 2 children at this center.

F. Provide the hand generator and the light bulb socket in a center. Allow one child to hold the generator and another to turn the crank. Watch the gears! Allow 2 children at this center.

G. Provide the Carnival Gears in a center. (These gears are essentially the same as the Circus Gears.) These gears can also be built vertically. Challenge the children to build up, not just flat with these gears and watch them turn. Allow 2 children at this center.

H. Provide the Capsela Color Works in a center. Encourage the children to put the gears and pieces together to make a creation that spins when you turn the crank. Watch the gears at work! Allow 4 children at this center.

I. Provide a Spirograph or Spirotot in a center. Remind the children that the wheels really are gears. The teeth around the wheels help it work as it should. Allow 2 children at this center.

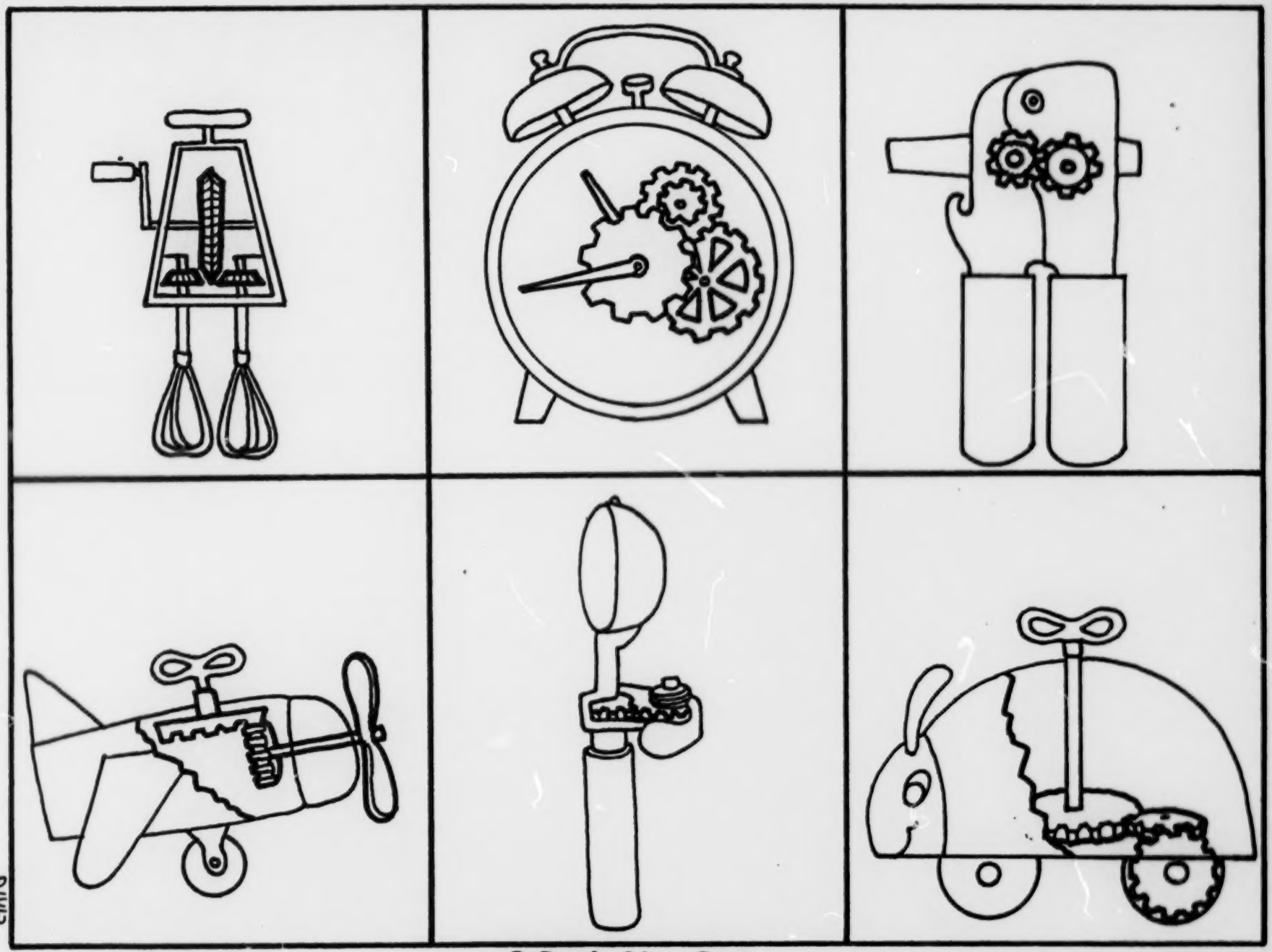
7. Two minutes before you are ready for the children to clean up, turn out the lights and make an announcement to warn them to begin finishing up whatever they are working on. After two minutes, turn out lights again and ask the children to clean up. Call children back to the group circle with a song. Allow each child to share one thing they learned or played with during center time. Review gears with the children and how they help us in our world.

8. Sing a good-bye song and collect the name tags.

RESOURCE KIT

1. Provide each classroom with a Gobs of Gears.

2. Use the patterns to make a lotto board to match pictures of gears inside everyday objects.



P442

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Fantastic Physics

Teacher Resource Activities

Four-Year-Olds

Physical Science
Resource Kit
Four Year Olds

Session 1: Magnets have special properties.

1. Place a magnet into each end of the wheeled cart. Encourage children to crash (attract) one cart into another. Then, see if children can make one cart run from (repel) the other.

2. Let children use the magnetic wands and junk to find objects that stick to the magnet. Let children sort these items from objects that don't stick. To this bag, add some common classroom objects such as scissors, buttons, popsicle sticks, keys, chalk, rocks, erasers, and pennies. Help children determine what the items that stick have in common.

3. Place some of the items that stick in the sandbox. Let children try to find the items using the magnet.

4. Place some of the items that stick in the water table. Let children retrieve them using the magnet.

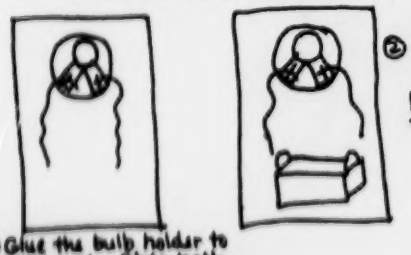
5. Let children use the magnetic chips with the magnetic wands or other magnets.

6. Tie a magnet to a string and suspend from a table. Let children hold various objects close to, but not touching, the magnet. Be sure to use objects that stick and objects that don't. The magnet will move toward items that stick.

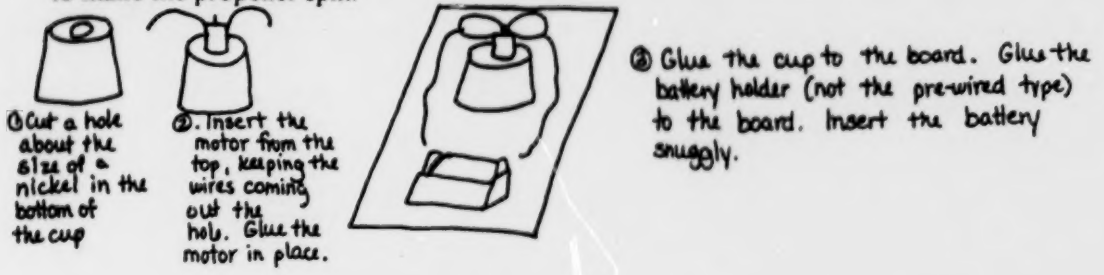
7. Place a piece of Plexiglas (at least 9"x12") on top of two large blocks to make a bridge with enough room underneath for a hand to fit. Lay a piece of paper on top of the Plexiglas and tape down. Drop several spoonfuls of paint onto paper. Put metal washers and nuts on paper. Let children hold magnet under Plexiglas and move it to make the washers and nuts paint a picture.

Session 2: Electricity comes from a source, travels along wires, and is a form of energy.

1. Use two battery holders, two bulb sockets, two light bulbs, and a 5"x 7" board. For each unit, glue the bulb socket to a board. Wire the bulb socket only, leaving wires unattached to the battery. Insert a battery in the battery holder. Now the children can touch the wires to the battery holder to complete the circuit to make the bulb light.


① Glue the bulb holder to the board. Strip both ends of 2 pieces of wire. Attach one end of each wire to the bulb holder.
② Glue the battery holder (NOT the pre-wired type) to the board.
③ Insert battery snuggly in holder.

2. Use a battery holder, motor, propeller, small bathroom size plastic cup, and a 5"x 7" board. Cut a hole in the bottom of the cup large enough for the motor. Insert the motor from the top and leave the wires so they come out the top. Hot glue the motor in the hole. Hot glue the battery holder and the cup to the board. Attach the propeller to the motor. Now the children can touch the wires to the battery holder to complete the circuit to make the propeller spin.


① Cut a hole about the size of a nickel in the bottom of the cup
② Insert the motor from the top, keeping the wires coming out the hole. Glue the motor in place.
③ Glue the cup to the board. Glue the battery holder (not the pre-wired type) to the board. Insert the battery snuggly.

3. Use the energy ball to demonstrate to children how the circuit must be complete (forms a circle) in order to get the ball to light. Have the children hold the energy ball to complete the circle and watch the ball glow.

Session: Light has special properties.

1. Use one copy of each of the patterns numbered P431. Color the outlined pictures of items black to resemble shadows. Leave this sheet whole and use as a lotto board. Color the detailed pictures. Cut apart the detailed sheet into cards that can be matched to the shadow pictures on the lotto board. For more of a challenge, both sheets can be cut into cards and matched.

2. Use one copy of each of the patterns numbered P432. Color and cut the half-completed pictures. Let children use mirrors to complete the picture.

3. Make four unbreakable mirrors. each mirror, lay a piece of heavy aluminum foil, shiny side up, on a piece of mat board. On top of the foil, lay a piece of clear acetate the same size as the mat board. Trim the excess aluminum foil. Put a thin band of clear tape around the edges to seal. Two of the mirrors can then be taped together to form a hinged mirror.

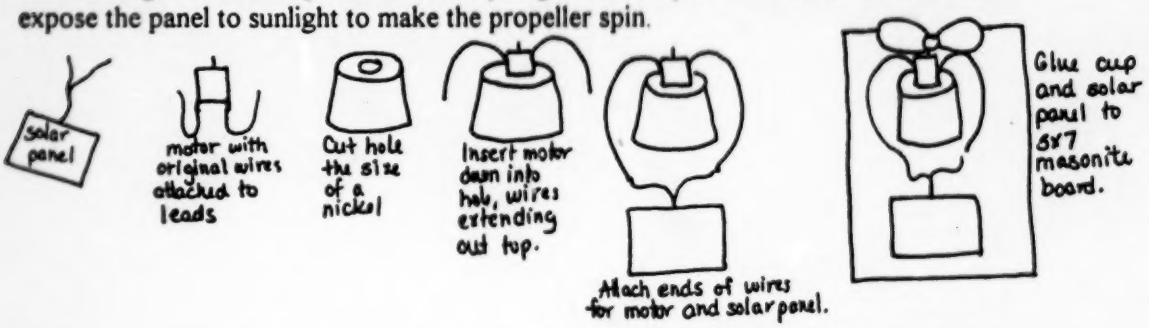
4. Provide a variety of catalog pictures for the children to use with the hinged mirror.

5. Place confetti, sequins, or beads in small plastic zippered bags and let children explore with them using the hinged mirror.

6. Use the Solargraphics kit to make sun prints of many common objects.

7. Use a solar panel, motor, propeller, small bathroom size plastic cup, and a 5"x 7" board. Cut a hole in the bottom of the cup large enough for the motor. Insert the motor

from the top and leave the wires so they come out the top. Hot glue the motor in the hole. Hot glue the solar panel and the top edge of the cup to the board. The children expose the panel to sunlight to make the propeller spin.


solar panel
motor with original wires attached to leads
Cut hole the size of a nickel
Insert motor down into hole, wires extending out top.
Attach ends of wires for motor and solar panel.
Glue cup and solar panel to 8x7 masonite board.

8. Place a variety of objects on a table with a flashlight. Let children make the shadows change from large to small. Help children change the angle of the flashlight to change the shadows.

9. Take children outside in the morning and draw an outline of their feet and their shadows. Come back outside several times during the day. Have children stand in their footprints. Draw their shadows again each time to see how they have changed.

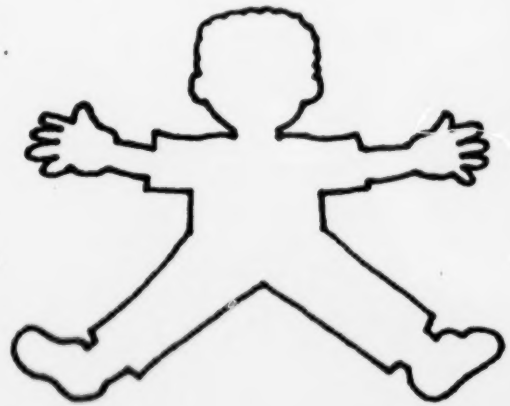
10. Make a shadow box. Cut a hole out of the bottom of a large (boot size) shoe box. Cover the hole with a thin paper such as typing paper, and tape it to the box. Stand the box on its longest side. Shine a light source into the open end of the box at the paper. Children can use stencils or other shapes to create shadows. Tape the stencil to a ruler or a straw. Let children insert their shapes into the box in front of the flashlight. The shadows will appear on the outside of the box on the white paper. Use the shadow box to play a game with the children. Hold up a stencil in the box and see if the children can guess what it is from its shadow.

11. Cut photographs of the children in half. Let children complete the pictures with mirrors. Talk to children about the fact that a human face is not symmetrical.

Session 4: Machines help us do work.

1. Let children explore with Gobs of Gears.

2. Use two copies of the pattern P442. Color both sheets the same. Leave one sheet whole to use as a lotto board. Cut the other sheet into cards. Play lotto by matching the cards to the lotto board.



pg31

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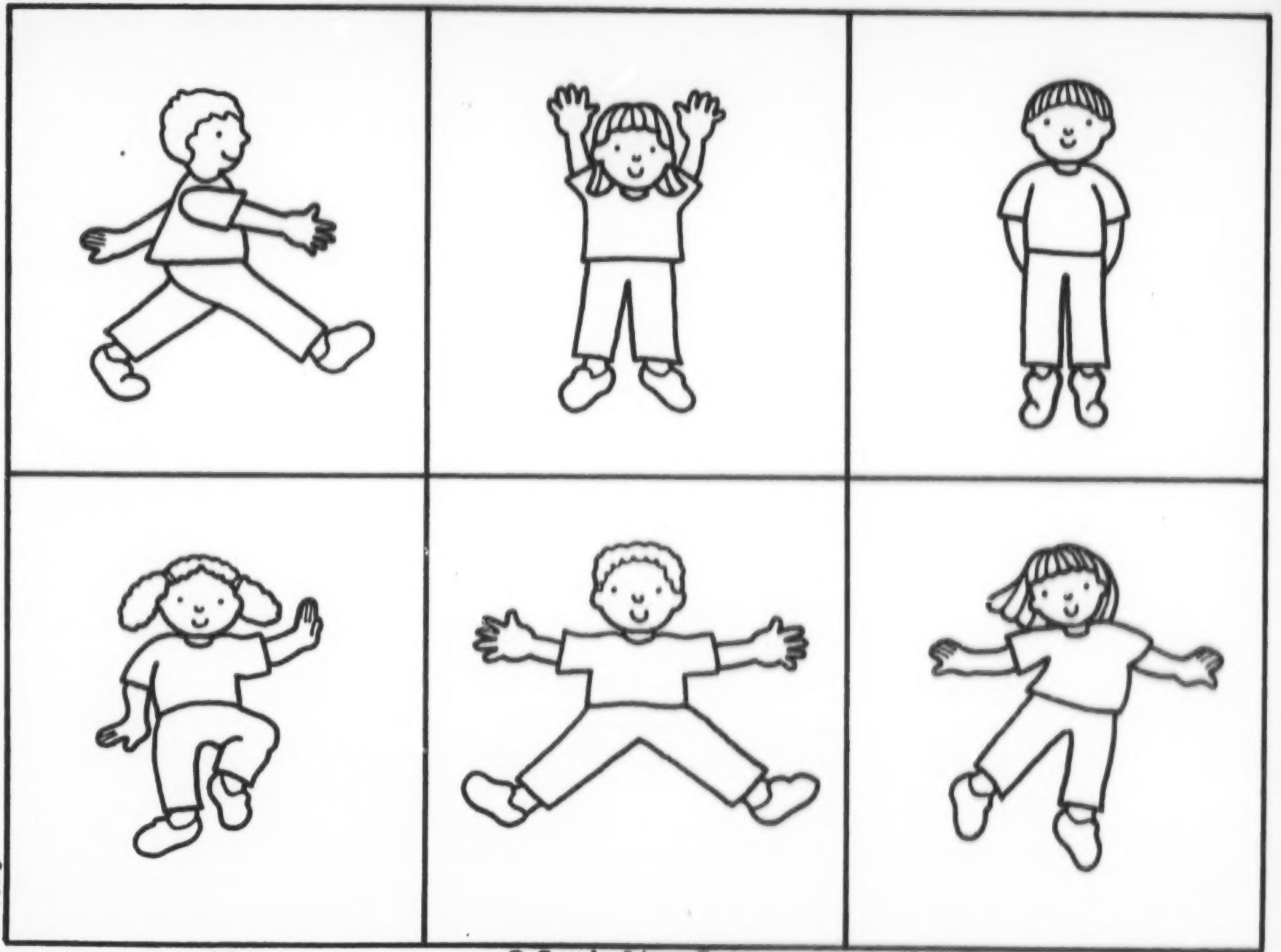

p431

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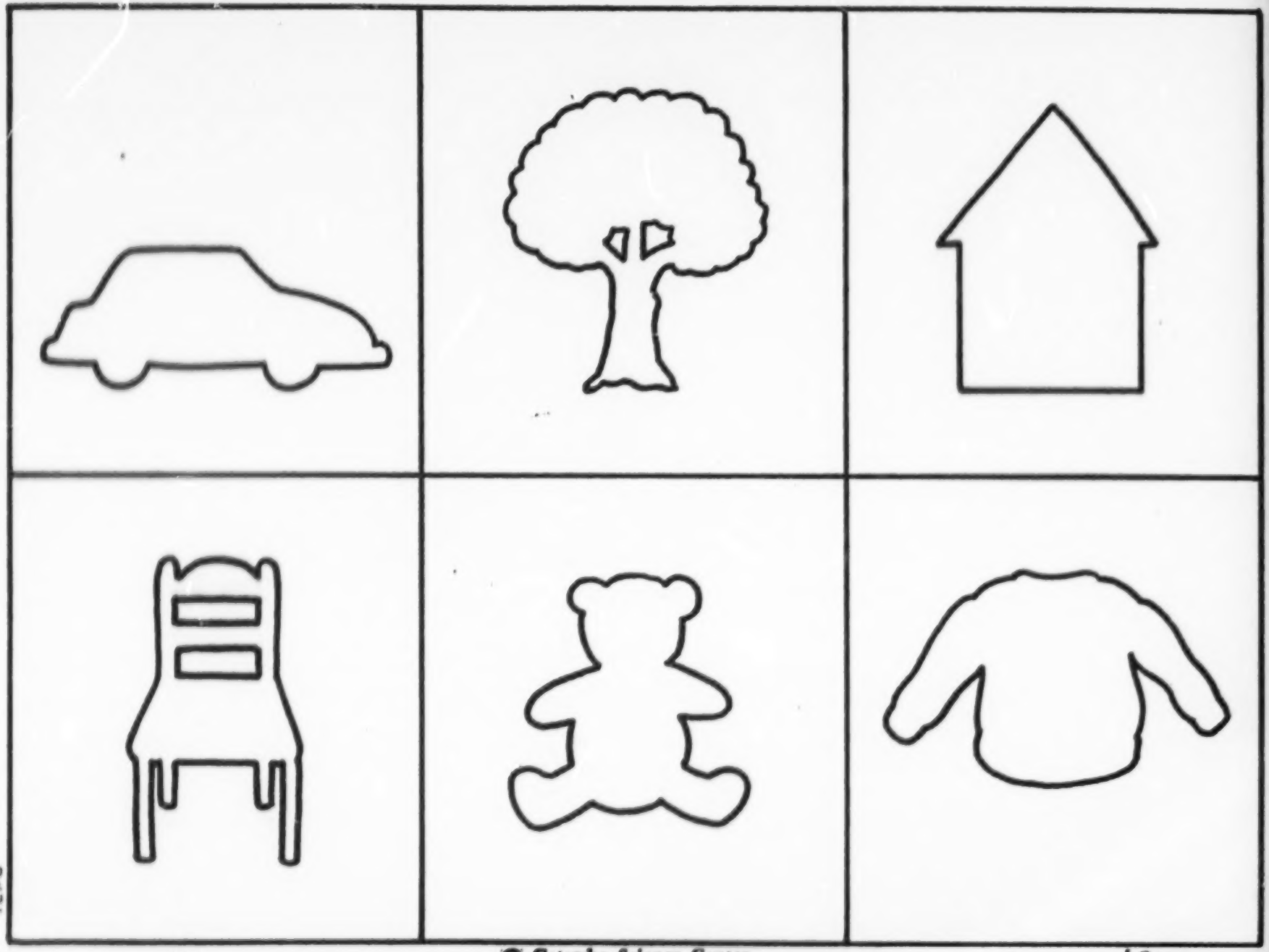

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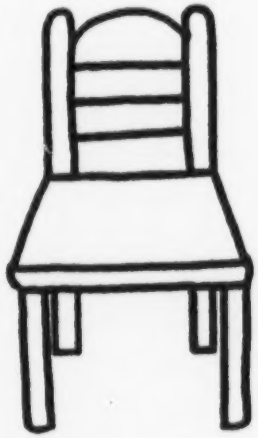

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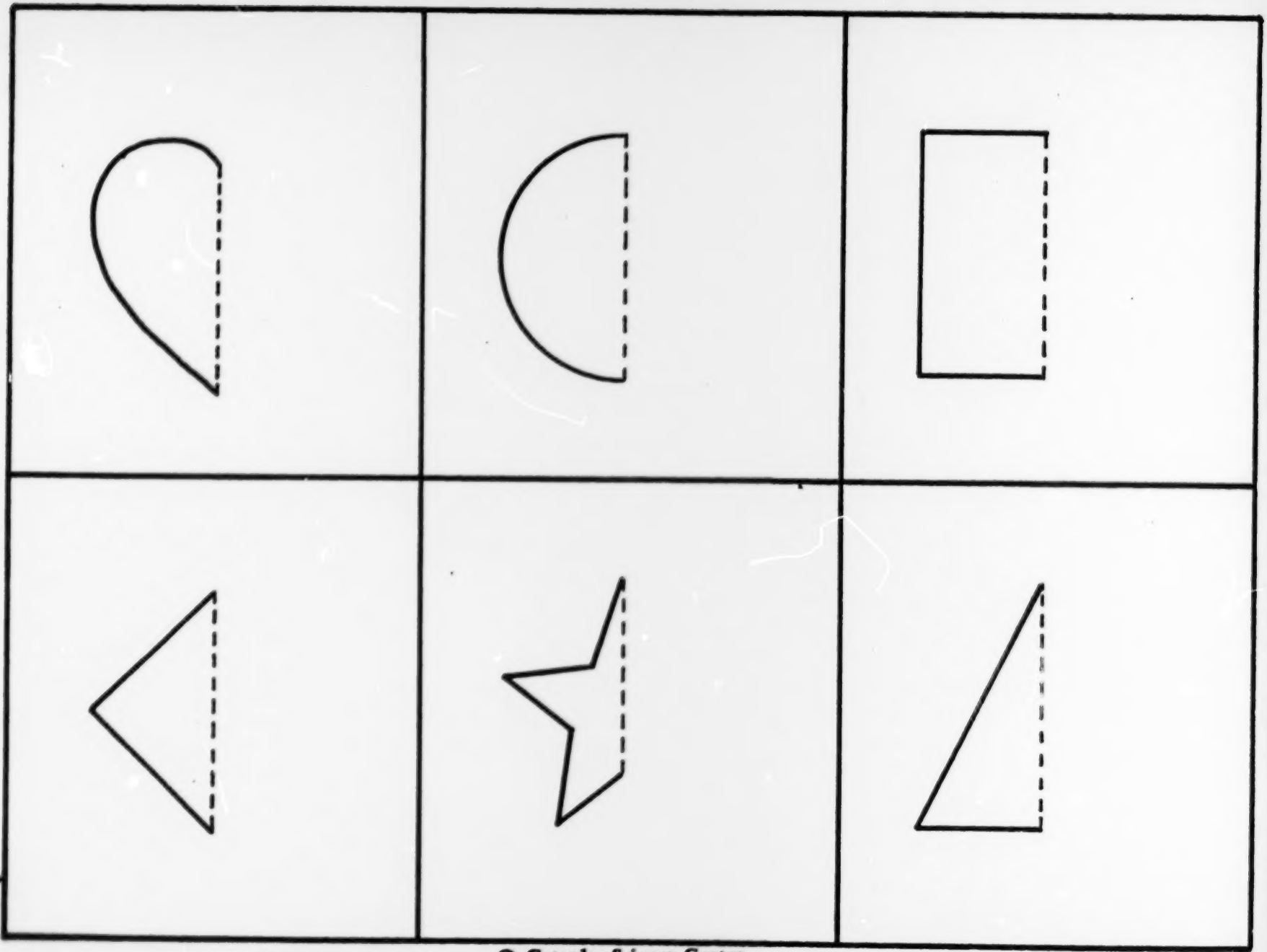

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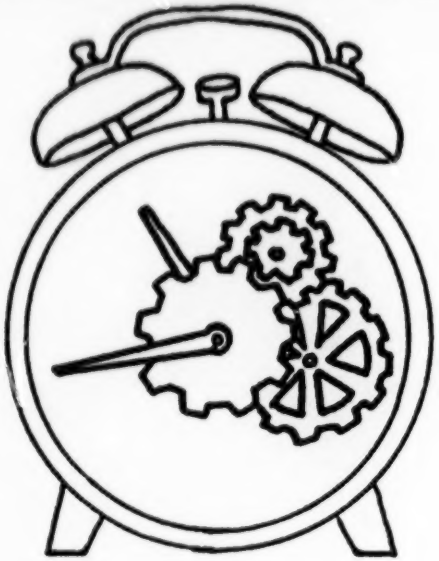

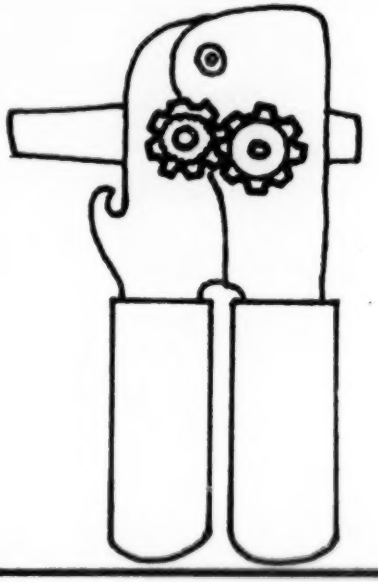

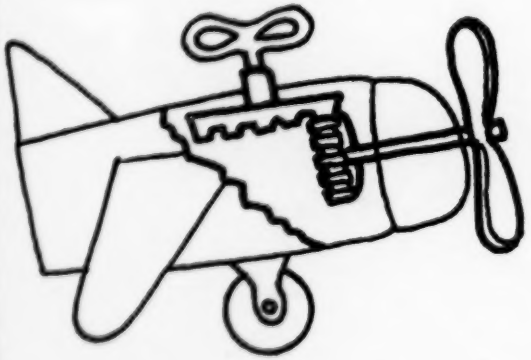

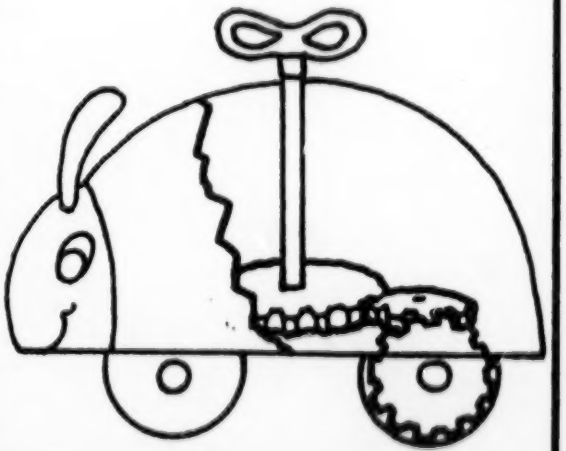

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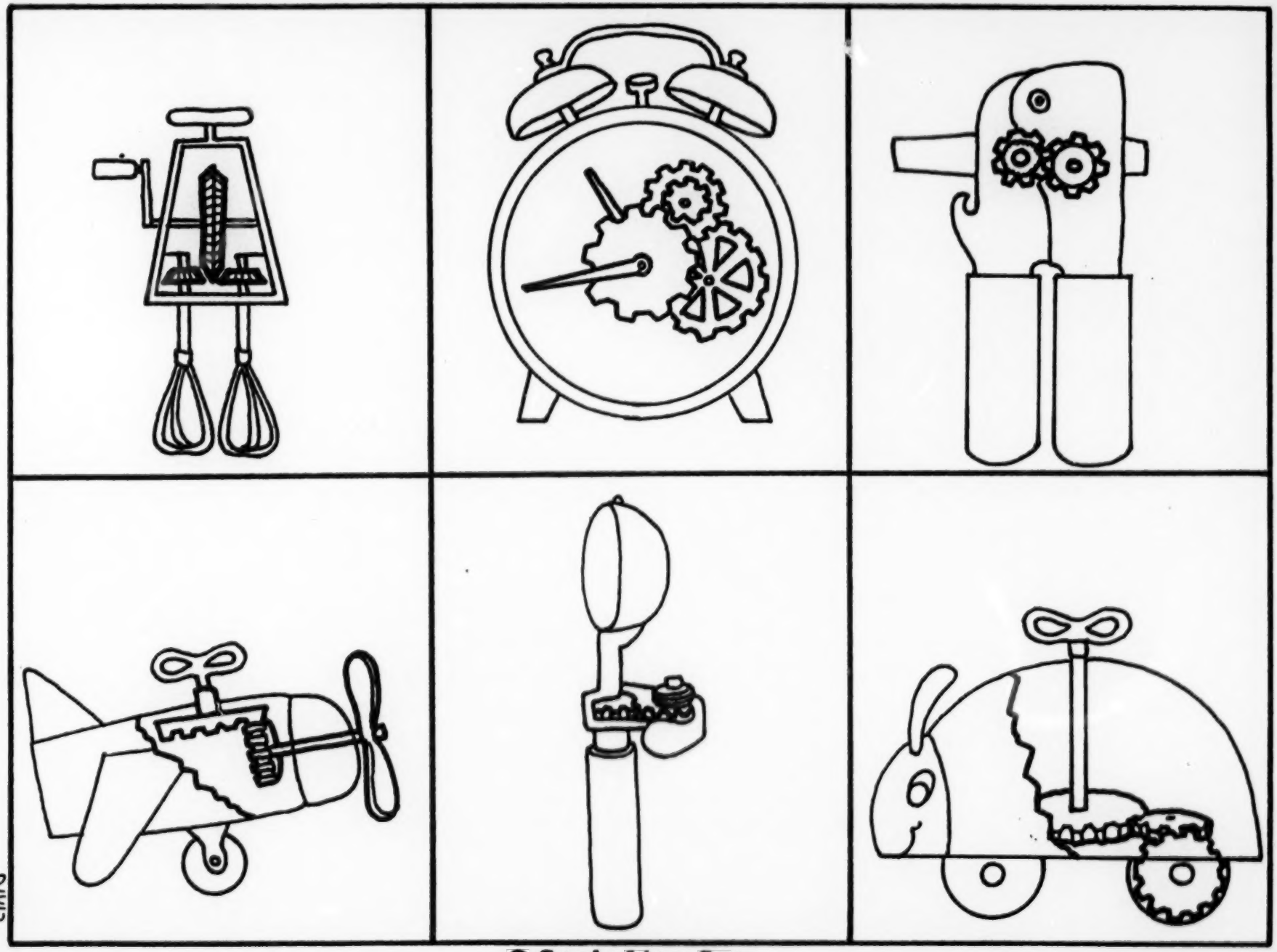

P442

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Fantastic Physics

Books and Fingerplays

Three-Year-Olds
Four-Year-Olds

Physics
Books

Switch On, Switch Off **written by Melvin Berger**

Light **written by Donald Crews**

Shadow **written by Blaise Cendrars**

Shadows: here, there and everywhere **written by Ron Goor**

My Shadow **written by Sheila Gore**

Shadow Magic **written by Seymour Simon**

I Have A Friend **written by Keiko Narahashi**

Machines At Work **written by Byron Barton**

Color Seems **written by Ilma Haskins**

Is It Red? Is It Yellow? Is It Blue? An Adventure in Color **written by Tana Hoban**

Colors **written by Shirley Hughes**

Light and Color **written by L.W. Anderson**

Shadow Magic **written by Simon Seymour**

Light **written by Angela Webb**

Discovering Electricity **written by Rae Bains**

Mickey's Magnet **by Franklyn M. Branley and Eleanor K. Baughn**

Look at Magnets **written by Rena K. Kirkpatrick**

Machines **written by Anne and Harlow Rockwell**

Energy From the Sun **written by Melvin Berger**

True Book of Magnets and Electricity **written by Illa Podendorf**

Story of Electricity **written by Mae B. Freeman and Ira M. Freeman**

Electricity **written by Edward Victor**

Electricity: A book to begin on **written by Leslie Waller**

Look in the Mirror **written by Sam and Beryl Epstein**

Mirror on the Wall: How it Works **written by Phillip B. Carona**

What Is Light? **written by Theodore Munch**

The First Book of Color **written by Herbert P. Paschell**

Color My World **written by Wayne Carley**

Light and Dark **written by Seymour Simion**

Fantastic Physics
Songs and Fingerplays
Resources

More Piggy Back Songs by Jean Warren, 1984
See My Shadow
Oh Rainbow, Oh Rainbow

Piggy Back Songs by Jean Warren, 1984
My Favorite Machine

The following fingerplays/songs were written by Karla Payne, MA.

Do You See Your Shadow? (Sung to "Mary Had A Little Lamb")

Do you see your shadow, shadow, shadow?
Do you see your shadow,
There on the ground?

Yes, I see my shadow, shadow, shadow,
Yes, I see my shadow,
There on the ground.

I don't see my shadow, shadow, shadow,
I don't see my shadow.
The sun has gone away.

Did You Ever See A Magnet? (Sung to "Did You Ever See A Lassie?")

Did you ever see a magnet attract and repel?
Attract and repel, attract and repel?
Did you ever see a magnet attract and repel?

Did you ever see a magnet attract and repel?
It pushes and pulls, it pushes and pulls.
Did you ever see a magnet attract and repel?

This is the Way the Gears Turn (Sung to "Here We go Round the Mulberry Bush")

This is the way the gears turn, gears turn, gears turn.
This is the way the gears turn to help us do our work.

The gears make the motor work, motor work, motor work.
The gears make the motor work, as they help us do our work.

The gears make the pieces turn, pieces turn, pieces turn.
The gears make the pieces turn, as they help us do our work.

This is the Way That Light Helps Us (Sung to "The Mulberry Bush")

This is the way the light helps us, light helps us, light helps us.
This is the way that light helps us, it helps us see so many things.

This is the way the light helps us, light helps us, light helps us.
This is the way that light helps us, it helps us see all the colors.

This is the way the light helps us, light helps us, light helps us.
This is the way that light helps us, it helps us see in the mirror.

Batteries Help Us (Sung to "Frere Jacques")

Batteries help us, batteries help us
To make things work, to make things work,
They help us make our toys run, they help us make our toys run,
They help us to have fun, they help us to have fun.